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Special Provision for Quality Control/Quality Assurance of
Bituminous Concrete Mixtures

January 11, 2002

This special provision has been resurrected to remove the pay item QC/QA Bituminous and make the work included in the various bituminous contract items. Minor corrections and clarifications have been made as well. This special provision replaces Check Sheet 15 of the Recurring Special Provisions.

This special provision should be inserted into all bituminous contracts.

The districts should include the BDE Check Sheet marked with the applicable special provisions for the April 26, 2002 and subsequent lettings. The Project Development and Implementation Section will include the paper copy in the contract.

This special provision will be transferred through the E-mail System to the district offices on January 11, 2002.

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QUALITY CONTROL/QUALITY ASSURANCE OF BITUMINOUS CONCRETE MIXTURES (BDE)

Effective: July 1, 1996

Revised: January 1, 2002

Description. This special provision establishes and describes the quality control responsibilities of the Contractor in producing and constructing bituminous concrete mixtures and defines the quality assurance and acceptance responsibilities of the Engineer for Quality Management Projects.

The Contractor, by application for and receipt of prequalification, by submission of a bid, and if awarded the contract, by execution of the Contract containing this special provision, certifies that he/she: fully and thoroughly understands all aspects and requirements of this special provision; possesses the latest edition of and thoroughly understands all aspects and requirements of the procedures, manuals, and documents referred to and incorporated by reference in this special provision; and waives and releases any and all claims of misunderstanding or lack of knowledge of the same. Furthermore, the Contractor understands and agrees that compliance with the requirements of this special provision and of the Annual Quality Control Plan and job-specific Quality Control Addenda approved by the Engineer is an essential element of the Contract. Failure to comply with these requirements can result in one or more of the following: a major breach of this contract and default thereof, a loss of prequalification, and a suspension of the Contractor from bidding.

Bituminous concrete mixtures shall be produced and constructed according to the appropriate Section(s) of the Standard Specifications and the following.

The following is a listing of bituminous concrete quality control/quality assurance documents:

- (a) Model Annual Quality Control (QC) Plan for Hot-Mix Asphalt (HMA) Production
- (b) Model Quality Control (QC) Addenda for Hot-Mix Asphalt (HMA) Production
- (c) Bituminous Concrete QC/QA Laboratory Equipment
- (d) Illinois Modified ASTM D 2950, Standard Test Method for Determination of Density of Bituminous Concrete In-Place by Nuclear Method
- (e) Standard Test Method for Correlating Nuclear Gauge Densities with Core Densities
- (f) Bituminous Concrete QC/QA Start-Up Procedures
- (g) Bituminous Concrete QC/QA QC Personnel Responsibilities and Duties Checklist
- (h) Bituminous Concrete QC/QA Initial Daily Plant and Random Samples
- (i) Determination of Random Density Test Site Locations
- (j) Bituminous Concrete QC/QA Control Charts/Rounding Test Values
- (k) Bituminous Mixture Design Verification Procedure
- (l) Development of Gradation Bands on Incoming Aggregate at Mix Plants
- (m) Procedure for Asphalt Content of Bituminous Concrete Mixtures by the Nuclear Method (Modified AASHTO T 287-90)

Materials.

- (a) Class I Bituminous Concrete Mixtures. All aggregates shall be produced according to the Department's "Aggregate Gradation Control System". Gradations other than those specified in Sections 1003 and 1004 of the Standard Specifications produced according to the Department's "Aggregate Gradation Control System" may be used for Class I Types 1, 2, and 3 mixtures.
- (b) Non-Class I Bituminous Concrete Mixtures. Materials shall be according to the Standard Specifications for each mixture listed:

| Mix Type | Article |
|------------------------------|---------|
| Bituminous Aggregate Mixture | 312.03 |
| Base Course | 355.02 |
| Base Course Widening | 356.02 |
| Class B (Plant Mix) | 405.02 |
| Shoulder | 482.02 |

If the Contractor receives approval to use a Class I mixture where not required by the contract, either Quality Control program may be used at the Contractor's option.

Equipment. The Contractor may utilize innovative equipment or techniques according to Section 1100 of the Standard Specifications.

- (a) Laboratory. The Contractor shall provide a laboratory, at the plant, approved annually by the Engineer. Any other laboratory location will require approval by the Engineer. The laboratory shall be of sufficient size and be furnished with the necessary equipment and supplies for adequately and safely performing the Contractor's quality control testing. The Contractor is referred to the Department's "Model Annual Quality Control Plan for Hot-Mix Asphalt (HMA) Production" for detailed information on the required laboratories. The required laboratory equipment for production and mix design is listed in the Department's "Bituminous Concrete QC/QA Laboratory Equipment."

The laboratory and equipment furnished by the Contractor shall be properly maintained. The Contractor shall maintain a record of calibration results at the laboratory. The Engineer may inspect measuring and testing devices at any time to confirm both calibration and condition. If the Engineer determines the equipment is not within the limits of dimensions or calibration described in the appropriate test method, the Engineer may stop production until corrective action is taken. If laboratory equipment becomes inoperable, the Contractor shall cease mix production.

- (b) Plant Requirements. The Contractor shall provide documentation that the bituminous plants have been calibrated and approved. The Engineer or his/her representative will witness the calibration. This information shall be documented on the appropriate forms and be submitted to the Engineer before any bituminous mix production begins.

Quality Control Plan and Addenda. The approved Annual QC Plan and QC Addenda shall become part of the contract between the Department and the Contractor but shall not be construed, in itself, as acceptance of any bituminous mixture produced. Failure to execute the contract according to the approved Annual QC Plan and QC Addenda will result in suspension of bituminous mix production or other appropriate actions as directed by the Engineer.

The Contractor shall submit in writing to the Engineer a proposed Annual Quality Control (QC) Plan for each bituminous concrete plant for approval before each construction season. Job-specific QC Addenda to the Annual QC Plan must be submitted in writing to the Engineer for approval before the pre-construction conference. The Annual QC Plan and the QC Addenda shall address all elements involved in the production and quality control of the bituminous mixtures incorporated in the project. The proposed QC Plan shall be the Department's "Model Annual Quality Control Plan for Hot-Mix Asphalt (HMA) Production", and the QC Addenda shall be the Department's "Model Quality Control Addendum for Hot-Mix Asphalt (HMA) Production".

The Contractor may propose revisions to portions of the Department's Annual QC Plan and QC Addenda. Revisions require proper justification be provided to the Department by the Contractor to ensure product quality. Any revision in the Annual QC Plan or QC Addenda must be approved in writing by the Engineer.

Construction of bituminous items subject to the Contractor's quality control shall not begin without approval of the Annual QC Plan and QC Addenda by the Engineer.

The Contractor will be notified in writing upon approval of the Annual QC Plan and QC Addenda by the Engineer.

The Annual QC Plan and QC Addenda may be amended during the progress of the work, by either party, subject to mutual agreement. Revisions require proper justification be provided to the Department to ensure product quality. The Contractor will be notified in writing by the Engineer upon approval of any amendments to the Annual QC Plan and/or QC Addenda.

Mix Design Requirements. The Contractor shall provide mix designs for each type of required mixture. The mixture design shall be performed and documented according to the Department's current Bituminous Concrete Level III Technician Course manual entitled "Bituminous Mixture Design Procedure". Each specific mixture design shall be submitted to and verified by the Department as detailed in the Department's current "Bituminous Mixture Design Verification Procedure."

- (a) Class I Bituminous Concrete Mixtures. The mixture shall be designed according to the criteria stated in Article 406.13 of the Standard Specifications and the contract.

- (b) Non-Class I Bituminous Concrete Mixtures. The 50-blow Marshall mixture design criteria listed below shall apply.

| Mix Type | Minimum Stability kN (lb) | Maximum Flow 0.25 mm (0.01 in.) | Air Voids % |
|------------------------------|------------------------------|------------------------------------|----------------|
| Bituminous Aggregate Mixture | 6.6 (1500) | 19 | 3 ± 1 |
| Base Course | 6.6 (1500) | 19 | 3 ± 1 |
| Base Course Widening | 6.6 (1500) | 19 | 3 ± 1 |
| Class B (Plant Mix) | 6.6 (1500) | 19 | 3 ± 1 |
| Shoulder | 6.6 (1500) | 19 | 2 ± 1 |

Specific mixture designs may be assigned to more than one project or plant and may be used from one construction season to the next provided the designs are resubmitted for verification according to the Department's "Bituminous Mixture Design Verification Procedure". In no case shall aggregates from a different source be substituted in a specific mixture design without complete redesign of the mixture.

The mix design shall be developed, performed, and tested by qualified personnel in a mix design laboratory approved by the Department, using the Department's current Level III procedure. For personnel requirements, see the section in this provision entitled, "Quality Control by Contractor".

Start Of Mix Production And Job Mix Formula (JMF) Adjustments. The job mix formula (mix design) represents the aggregate grading and asphalt content that produce the desired mix criteria in the laboratory.

- (a) Class I Bituminous Concrete Mixtures. During the mixture start-up the Contractor shall follow the Department's "Bituminous Concrete QC/QA Start-Up Procedures". Article 406.15(b) of the Standard Specifications shall not apply.

At the start of mix production, QC/QA mixture start-up will be required for the following situations: at the beginning of production of a new mixture design, at the beginning of each production season, and at every plant utilized to produce mixtures, regardless of the mix.

Before start-up, target values shall be determined by applying gradation correction factors to the JMF when applicable. These correction factors shall be determined from previous experience. The target values, when approved by the Engineer, shall be used to control mix production. Plant settings and control charts shall be set according to target values.

In the field, slight adjustments to the JMF or minor changes in cold-feed/hot-bin blends may be necessary to obtain the desired air voids, density, uniformity, and constructibility. After any JMF adjustment, the JMF shall become the adjusted job mix formula (AJMF). Upon completion of the first acceptable test strip, the JMF shall become the AJMF.

regardless of whether or not the JMF has been adjusted. If an adjustment/plant change is made, the Engineer may require a new test strip to be constructed. If the bituminous mixture placed during the initial test strip is determined to be unacceptable to remain in place by the Engineer, it shall be removed and replaced.

Any adjustments outside the above limitations will require a new mix design. The limitations between the JMF and AJMF are as follows:

| Parameter | Adjustment |
|-------------------|------------|
| 12.5 mm (1/2 in.) | ± 5.0% |
| 4.75 mm (No. 4) | ± 4.0% |
| 2.36 mm (No. 8) | ± 3.0% |
| 600 µm (No. 30) | * |
| 75 µm (No. 200) | * |
| Asphalt Content | ± 0.3% |

*In no case shall the target for the amount passing be greater than the JMF.

After an acceptable test strip, including required plant tests, production of mix shall be restarted the same day, and an acceptable rolling pattern shall be established in the first 180 metric tons (200 tons) of mix produced. Paving may continue for the remainder of the day. After an acceptable rolling pattern has been established, it shall not be changed unless approved by the Engineer.

If a mixture start-up is not required, an acceptable rolling pattern shall be developed during the first 275 metric tons (300 tons) of each mixture produced.

A nuclear/core correlation, if required by the Engineer, shall follow the Department's "Standard Test Method for Correlating Nuclear Gauge Densities with Core Densities" and shall be performed by the Contractor during the first production day.

Regardless which QC procedures are used during start of mix production, the next day's production shall not resume until all test results, including an acceptable nuclear/core correlation, are available and an AJMF is agreed upon by the Contractor and Engineer.

- (b) Non-Class I Bituminous Concrete Mixtures. In the field, slight adjustments to the gradation and/or asphalt content may be necessary to obtain the desired air voids, density, uniformity, and constructibility. These adjustments define the adjusted job mix formula (AJMF) and become the target values for quality control operations. Limitations between the JMF and AJMF are as follows. Any adjustments outside the limitations will require a new mix design.

| Parameter | Adjustment |
|-------------------|------------|
| 12.5 mm (1/2 in.) | ± 6% |
| 4.75 mm (No. 4) | ± 5% |
| 75 µm (No. 200) | ± 2.5% |
| Asphalt Content | ± 0.5% |

Production is not required to stop after a growth curve has been constructed provided the test results are available to both the Contractor and Engineer before the following day's production.

During production the Contractor and Engineer shall continue to evaluate test results and mixture laydown and compaction performance. Adjustments within the above requirements may be necessary to obtain the desired mixture properties. If an adjustment/plant change is made, the Engineer may request additional growth curves and supporting plant tests.

Quality Control by Contractor. The Contractor shall perform or have performed the inspection and tests required to assure conformance to contract requirements. Control includes the recognition of obvious defects and their immediate correction. This may require increased testing, communication of test results to the plant or the job site, modification of operations, suspension of bituminous mix production, rejection of material, or other actions as appropriate.

The Engineer shall be immediately notified of any failing tests and subsequent remedial action. Passing tests shall be reported to the Engineer no later than the start of the next work day.

- (a) Personnel. The Contractor shall provide a Quality Control (QC) Manager who shall have overall responsibility and authority for quality control. This individual shall have successfully completed the Department's Bituminous Concrete Level II Technician Course, "Bituminous Concrete Proportioning and Mixture Evaluation".

In addition to the QC Manager, the Contractor shall provide sufficient personnel to perform the required visual inspections, sampling, testing, and documentation in a timely manner. Mix designs shall be developed by personnel who have successfully completed the Department's Bituminous Concrete Level III Course, "Bituminous Mixture Design Procedure". All technicians who shall be performing mix design testing and plant sampling/testing shall have successfully completed the Department's Bituminous Concrete Level I Technician Course, "Bituminous Concrete Testing". The Contractor may also provide a Gradation Technician who has successfully completed the Department's "Gradation Technician Course" to run gradation tests only under the supervision of a Bituminous Concrete Level II Technician. The Contractor shall provide a Bituminous Concrete Density Tester who has successfully completed the Department's "Bituminous Concrete Nuclear Density Testing Course" to run all required density tests on the job site.

All quality control personnel shall perform the required quality control duties. The Contractor is referred to the Department's "QC Personnel Responsibilities and Duties Checklist" for a description of personnel qualifications and duties. Testing shall be conducted to control the production of the bituminous mixture.

- (b) Plant Tests. The Contractor shall use the test methods identified to perform the following mixture tests at a frequency not less than that indicated:

| Parameter | Frequency of Tests Class I Mixtures | Frequency of Tests Non-Class I Mixtures | Test Method |
|--|---|---|--|
| Aggregate Gradation Hot bins for batch and continuous plants. Individual cold- feeds or combined belt-feed for drier- drum plants. % passing sieves: 12.5 mm (1/2 in.), 4.75 mm (No. 4), 2.36 mm (No. 8), 600 μ m (No. 30), 75 μ m (No. 200) | 1 dry gradation per half day of production. Every third test shall be a washed ignition oven (or extraction) test on the mix, to be plotted on the control charts for the purposes of monitoring dust control. | 1 dry gradation per day of production. The first day of production requires the initial test to be washed; every eighth test thereafter shall be washed. % passing sieves: 12.5 mm (1/2 in.), 4.75 mm (No. 4) 75 μ m (No. 200) | Illinois Procedure (See Manual of Test Procedures for Materials). |
| Asphalt Content by Nuclear Gauge (or Ignition Oven if approved by the Engineer) | 1 per half day of production | 1 per day | Illinois Modified AASHTO T 287 (Illinois Modified AASHTO TP308) |
| Air Voids Bulk Specific Gravity Maximum Specific Gravity of Mixture | 1 per half day of production for first 2 days and 1 per day thereafter (first sample of the day) | 1 per day 1 per day | Illinois Modified AASHTO T 166 Illinois Modified AASHTO T 209 |

Article 406.10 of the Standard Specifications shall not apply except the ratio of minus 75 μ m (minus No. 200) material to asphalt content during production shall not be less than 0.6 nor more than 1.2.

Contractor testing of all plant test samples shall be complete within 3 1/2 hours of sampling.

The Contractor may apply the following for small tonnage of mixture: Combined belt/hot-bin analysis, voids, and asphalt content tests may not be required on a specific mixture if the day's production is less than 225 metric tons (250 tons) per mix. A minimum of one set of plant tests for each mix shall be performed for each five consecutive production-day period when the accumulated tonnage produced in that period exceeds 450 metric tons (500 tons). A Bituminous Concrete Level II Technician

shall oversee all quality control operations. If the required tonnage of any mixture for a single pay item is less than 225 metric tons (250 tons) in total, the Contractor shall state his/her intentions of waiving the "Required Plant Tests" in the QC Addenda. The mixture shall be produced using a mix design that has been verified as specified and validated by the Department's recent acceptable field test data. A Bituminous Concrete Level II Technician shall oversee all quality control operations for the mixture.

1L (1 qt) samples of each asphalt cement (AC) type used shall be taken by the Contractor and will be witnessed by the Engineer. The minimum sampling frequency shall be twice a month. Asphalt cement sample containers will be furnished by the Department. The Engineer will submit the properly identified AC samples to the Bureau of Materials and Physical Research for testing.

For bituminous mixture sampling the Contractor shall obtain required plant samples as directed in the Department's "Bituminous Concrete QC/QA Initial Daily Plant and Random Samples". The Contractor shall split all required samples and identify the split samples per the Engineer's instructions. These split samples shall be retained by the Contractor for assurance testing by the Engineer and be disposed of only with the permission of the Engineer. The split samples shall be stored in a dry, protected location.

The Contractor shall, when necessary, take and test additional samples (designated "check" samples) at the plant during mix production. These samples in no way replace the required plant samples described above. Check samples shall be tested only for the parameters deemed necessary by the Contractor. Check sample test results shall be noted in the Plant Diary and shall not be plotted on the control charts. The Contractor shall detail the situations in which check samples will be taken in his/her Annual QC Plan.

- (c) Required Field Tests. The Contractor shall control the compaction process by testing the mix density at random locations as determined according to the Department's current "Determination of Random Density Test Site Locations" and recording the results on forms approved by the Engineer. The Contractor shall follow the density testing procedures detailed in the Department's "Illinois Modified ASTM D 2950, Standard Test Method for Determination of Density of Bituminous Concrete In-Place by Nuclear Method".

(1) Class I Bituminous Concrete Mixtures.

The Contractor shall be responsible for establishing the correlation to convert nuclear density results to core densities according to the Department's "Standard Test Method for Correlating Nuclear Gauge Densities with Core Densities". The Engineer may require a new nuclear/core correlation if the Contractor's gauge is recalibrated during the project.

If the Contractor and Engineer agree the nuclear density test method is not appropriate for the mixture, cores shall be taken at random locations determined according to the Department's "Determination of Random Density Test Site Locations". Three cores shall be taken at equal distances across the test site. These cores shall be averaged to provide a single test site result. Core densities shall be determined using the Illinois Modified AASHTO T 166 or T 275 procedure.

For Class I Types 1, 2 and 3 mixtures, quality control density tests shall be performed at randomly selected locations within 800 m (1/2 mile) intervals and for each lift of 75 mm (3 in.) or less in thickness. For lifts in excess of 75 mm (3 in.) in thickness, a test shall be performed within 400 m (1/4 mile) intervals. Testing of lifts equal to or greater than 150 mm (6 in.) compacted thickness shall be performed in the direct transmission mode according to the Department's "Illinois Modified ASTM D 2950, Standard Test Method for Determination of Density of Bituminous Concrete In-Place by Nuclear Method". Density testing shall be accomplished intermittently throughout the day. In no case shall more than one half day's production be completed without performing density testing.

Density tests shall be performed each day on patches located nearest the randomly selected location. The daily testing frequency shall be a minimum of two density tests per mix. Density testing shall be accomplished intermittently throughout the day. In no case shall more than one half day's production be completed without performing density testing.

(2) Non-Class I Bituminous Concrete Mixtures.

The Contractor shall perform a growth curve at the beginning of placement of each type of mix and each lift. The growth curve shall be constructed and evaluated according to the following procedure:

The growth curve for each type of mix and each lift shall be performed within the first 180 metric tons (200 tons). If an adjustment is made to the specific mix design, the Engineer reserves the right to request an additional growth curve and supporting tests at the Contractor's expense.

Compaction of the growth curve shall commence immediately after the course is placed and at a temperature of not less than 140 °C (280 °F). The growth curve, consisting of a plot of kg/cu m (lb/cu ft) vs. number of passes with the project breakdown roller, shall be developed. This curve shall be established by use of a nuclear gauge. Tests shall be taken after each pass until the highest kg/cu m (lb/cu ft) is obtained. This value shall be the target density provided the Marshall air voids are within acceptable limits. If Marshall air voids are not within the specified limits, corrective action shall be taken, and a new target density shall be established.

A new growth curve is required if the breakdown roller used on the growth curve is replaced with a new roller during production.

The target density shall apply only to the specific gauge used. If additional gauges are to be used to determine density specification compliance, the Contractor shall establish a unique minimum allowable target density from the growth curve location for each gauge. The Department will establish a target density for its Quality Assurance nuclear gauge from the growth curve location.

All lifts shall be compacted to an average density of not less than 95 percent nor greater than 102 percent of the target density obtained on the growth curve. The average density shall be based on tests representing one day's production.

Quality Control density tests shall be performed at randomly selected locations within 800 m (1/2 mile) intervals per lift per lane. In no case shall more than one half day's production be completed without density testing being performed.

If the Contractor is not controlling the compaction process and is making no effort to take corrective action, the operation shall stop as directed by the Engineer.

- (d) Control Limits. Target values shall be determined by applying adjustment factors to the AJMF where applicable. The target values shall be plotted on the control charts within the following control limits:

| Control Limits | | | |
|--|-------------------------|-----------------------------|-----------------------------|
| Parameter | Class I Individual Test | Class I Moving Average of 4 | Non-Class I Individual Test |
| % Passing: | | | |
| 12.5 mm (1/2 in.) | ± 6% | ± 4% | ± 15% |
| 4.75 mm (No. 4) | ± 5% | ± 4% | ± 10% |
| 2.36 mm (No. 8) | ± 5% | ± 3% | |
| 600 µm (No. 30) | ± 4% | ± 2.5% | |
| 75 µm (No. 200) | ± 1.5% | ± 1.0% | ± 2.5% |
| | | | |
| Total Dust Content 75 µm(No. 200) ¹ | ± 1.5% | ± 1.0% | ± 2.5% |
| | | | |
| Asphalt Content | ± 0.3% | ± 0.2% | ± 0.5 |
| | | | |
| Voids: | | | |
| Class I Type 1 | ± 1.2% | ± 1.0% | |
| Class I Type 2 | ± 1.2% | ± 1.0% | |
| Class I Type 3 | ± 1.2% | ± 1.0% | |
| Non-Class I - Shoulders | | | 2% ± 1% |
| Non-Class I - Others | | | 3% ± 1% |
| | | | |
| Density: | | | |
| Class I Type 1 | 92.0 - 96.0% | | |
| Class I Type 2 | 93 - 97% | | |
| Class I Type 3 | 93 - 97% | | |
| Non-Class I | | | Average 95-102% Target |

Note 1. Based on washed ignition oven

- (e) Control Charts. Standardized control charts shall be maintained by the Contractor at the field laboratory. The control charts shall be displayed and be accessible at the field laboratory at all times for review by the Engineer.

Individual required test results obtained by the Contractor shall be recorded on the control chart immediately upon completion of a test, but no later than 24 hours after sampling. Only the required plant tests and resamples shall be recorded on the control

chart. Any additional testing of check samples may be used for controlling the Contractor's processes, but shall be documented in the plant diary.

The results of assurance tests performed by the Engineer will be posted as soon as available.

The following parameters shall be recorded on standardized control charts as described in the Department's "Bituminous Concrete QC/QA Control Charts/Rounding Test Values".

Control limits for each required parameter, both individual tests and the average of four tests, shall be exhibited on control charts. Test results shall be posted within the time limits previously outlined.

| CONTROL CHART REQUIREMENTS | CLASS I MIXES | NON-CLASS I MIXES |
|---|--|---|
| Combined Gradation of Hot-Bin or Belt Aggregate Samples | % Passing Sieves: 12.5 mm (1/2 in.) 4.75 mm (No. 4) 2.36 mm (No. 8) 600 μ m (No. 30) 75 μ m (No. 200) | % Passing Sieves: 12.5 mm (1/2 in.) 4.75 mm (No. 4) 75 μ m (No. 200) |
| Total Dust Content of Washed Ignition Oven or Extraction ¹ | 75 μ m (No. 200) | 75 μ m (No. 200) |
| | Asphalt Content | Asphalt Content |
| | Bulk Specific Gravity | Bulk Specific Gravity |
| | Maximum Specific Gravity of Mixture | Maximum Specific Gravity of Mixture |
| | Voids | Voids |
| | Density | Density |

Note 1. Based on washed ignition oven

(f) Corrective Action for Required Plant Tests

(1) Individual Test Results. When an individual test result exceeds its control limit, the Contractor shall immediately resample and retest. If at the end of the day no material remains from which to resample, the first sample taken the following day shall serve as the resample as well as the first sample of the day. This result shall be recorded as a retest. If the retest passes, the Contractor may continue the required plant test frequency. Additional check samples should be taken to verify mix compliance.

a. Voids and Asphalt Content.

1. Class I Bituminous Concrete Mixtures. If the retest for voids or asphalt content exceeds control limits, mix production shall cease and immediate corrective action shall be instituted by the Contractor. After corrective action, mix production shall be restarted, the mix production shall be stabilized, and the Contractor shall immediately resample and retest. Mix production may continue when approved by the Engineer. The corrective action shall be documented.

Inability to control mix production is cause for the Engineer to stop the operation until the Contractor completes an investigation identifying the problems causing failing test results.

2. Non-Class I Bituminous Concrete Mixtures. If the retest for voids or asphalt content exceeds control limits, immediate corrective action shall be instituted by the Contractor. After corrective action, the Contractor shall immediately resample and retest. The corrective action shall be documented.

If corrective action has been initiated and the second resample fails, the Contractor shall cease operations. Failure to cease production shall subject all subsequently produced materials to be considered unacceptable.

Inability to control mix production is cause for the Engineer to stop the operation until the Contractor completes an investigation identifying the problems causing failing test results.

- b. Combined Aggregate/Hot-Bin. For combined aggregate/hot-bin retest failures, immediate corrective action shall be instituted by the Contractor. After corrective action, the Contractor shall immediately resample and retest. The corrective action shall be documented.

- (2) Moving Average. When the moving average values trend toward the moving average control limits, the Contractor shall take corrective action and increase the sampling and testing frequency. The corrective action shall be documented.

The Contractor shall notify the Engineer whenever the moving average values exceed the moving average control limits. If two consecutive moving average values fall outside the moving average control limits, the Contractor shall cease operations. Corrective action shall be immediately instituted by the Contractor. Operations shall not be reinstated without the approval of the Engineer. Failure to cease operations shall subject all subsequently produced material to be considered unacceptable.

- (3) Dust Control. If the washed ignition oven (for extraction) test results indicate a problem with controlling dust, corrective action to control the dust shall be taken and approved by the Engineer. If the Engineer determines that Positive Dust Control

Equipment is necessary, as outlined in the Bureau of Materials and Physical Research Policy Memorandum, "Approval of Hot Mix Bituminous Plants and Equipment", the equipment shall be installed prior to the next construction season.

(4) Mix Production Control. If the Contractor is not controlling the production process and is making no effort to take corrective action, the operation shall stop.

(g) Corrective Action for Required Field Tests (Density). When an individual density test exceeds the control limits, the Contractor shall immediately retest in a location that is halfway between the failed test site and the finish roller. If the retest passes, the Contractor shall continue the normal density test frequency. An additional density check test should be performed to verify the mix compaction.

If the retest fails, the Contractor shall immediately conduct one of the following procedures:

(1) Low Density. If the failing density retest indicates low densities, the Contractor shall immediately increase the compaction effort, review all mixture test results representing the mix being produced, and make corrective action as needed. The Contractor shall immediately perform a second density retest within the area representing the increased compaction effort and mixture adjustments.

(2) High Density. If the failing density retest indicates high densities, the Contractor shall cease production and placement until all mixture test results are reviewed and corrective action is taken. If the high density failure is a result of a change in the mixture, any existing material in the surge bin may be subject to rejection by the Engineer. After restart of mix production, a second density retest shall then be performed in the area representing the mixture adjustments.

If the second retest from either procedure passes, production and placement of the mix may continue. The increased compaction effort for low density failures shall not be reduced to that originally being used unless it is determined by investigation that the cause of the low density was unrelated to compaction effort, the cause was corrected, and tests show the corrective action has increased the density within the required limits.

If the second retest fails, production and placement of the mix shall cease until the Contractor has completed an investigation and the problem(s) causing the failing densities has/have been determined. If the Contractor's corrective action is approved by the Engineer, production and placement of the mix may then be resumed. The Contractor shall increase the frequency of density testing to show, to the satisfaction of the Engineer, that the corrective action taken has corrected the density problem.

If the Contractor is not controlling the compaction process and is making no effort to take corrective action, the operation, as directed by the Engineer, shall stop.

Quality Assurance By The Engineer. The Engineer will conduct independent assurance tests on split samples taken by the Contractor for quality control testing. In addition, the Engineer will witness the sampling and splitting of these samples a minimum of twice a month and will immediately retain the samples for quality assurance testing.

The overall testing frequency will be performed over the entire range of Contractor samples and will be equal to or greater than 10 percent for gradations and equal to or greater than 20 percent for asphalt content, bulk specific gravity, maximum specific gravity and field density. The Engineer may select any or all split samples for assurance testing. The Engineer will initiate independent assurance testing during mixture field verification. These tests may be performed immediately or anytime up to ten working days after sampling. The test results will be made available to the Contractor as soon as they become available.

The Contractor's nuclear/core correlation will be verified utilizing Department nuclear gauges.

The Engineer may witness the sampling and testing being performed by the Contractor. The Engineer will document all witnessed samples and tests.

The Engineer will promptly notify the Contractor, both verbally and in writing, of observed deficiencies. If the Engineer observes that the sampling and quality control tests are not being performed according to the applicable test procedures, the Engineer may stop production until corrective action is taken.

The Engineer may elect to obtain samples for testing, separate from the Contractor's quality control process, to verify specification compliance.

Differences between the Contractor's and the Engineer's split sample test results will be considered acceptable if within the following limits:

| Test Parameter | Acceptable Limits of Precision | |
|---|--------------------------------|-------------|
| | Class I | Non-Class I |
| % Passing: | | |
| 12.5 mm (1/2 in.) | 5.0% | 5.0% |
| 4.75 mm (No. 4) | 5.0% | 5.0% |
| 2.36 mm (No. 8) | 3.0% | |
| 600 μ m (No. 30) | 2.0% | |
| 75 μ m (No. 200) | 2.2% | 2.2% |
| | | |
| Total Dust Content 75 μ m (No. 200) ¹ | 2.2% | 2.2% |
| | | |
| Asphalt Content | 0.3% | 0.3% |
| | | |
| Maximum Specific Gravity of Mixture | 0.026 | 0.026 |
| | | |
| Bulk Specific Gravity | 0.045 | 0.045 |
| | | |
| Density (Percent Compaction) | 1.0% (Correlated) | 1.5%* |

Note 1. Based on washed ignition oven

*Applies to the final percentage difference between the gauges when compared against the individual target density of each gauge.

The Department may run extractions for assurance, when deemed necessary by the Engineer.

In the event comparison of the required plant test results is outside the above acceptable limits of precision, Department split or independent samples fail the control limits, a Department extraction indicates non-specification mix, or a continual trend of difference between Contractor and Department test results is identified, the Engineer will immediately investigate. The Engineer may suspend production as stated in Article 108.07 of the Standard Specifications, while the investigation is in progress. The investigation may include testing by the Engineer of any remaining split samples or a comparison of split sample test results on the mix currently being produced. The investigation may also include review and observation of the Contractor's technician performance, testing procedure, and equipment.

If a problem is identified with the mix, the Contractor shall take immediate corrective action. After corrective action, both the Contractor and the Engineer shall immediately resample and

retest following the procedures in Subsection "Corrective Action for Required Plant Tests", of the section in this provision entitled "Quality Control by Contractor".

In the event comparison of the required field test results (densities) are outside the above acceptable limits of precision, Department split or independent samples fail the density limits, or a continual trend of difference between Contractor and Department test results is identified, the Engineer will immediately investigate. The investigation will include testing by the Engineer of any remaining random density locations. The Engineer may establish additional locations for testing by both the Contractor and the Department to provide further comparison results. The investigation shall also include review and observation of the Density Tester performance, testing procedure, and equipment. The original correlation and/or comparison data, for both gauges, shall be reviewed as part of the investigation process. If the problem continues, the Engineer may require a new correlation be performed.

Acceptance By The Engineer. Final acceptance will be based on the following:

- (a) Validation of the Contractor's quality control by the assurance process.
- (b) The Contractor's process control charts and actions.
- (c) Department assurance tests for voids and density.

If any of the above are not met, the work will be considered in non-conformance with the contract.

Documentation. The Contractor shall be responsible for documenting all observations, records of inspection, adjustments to the mixture, test results, retest results, and corrective actions in a bound hardback field book or bound hardback diary which will become the property of the Department.

The Contractor shall be responsible for the maintenance of all permanent records whether obtained by the Contractor, the Contractor's consultants, or the producer of bituminous mix material.

The Contractor shall provide the Engineer full access to all documentation throughout the progress of the work.

Adjustments to mixture production and test results shall be recorded in duplicate and sent to the Engineer on forms approved by the Engineer.

Basis of Payment. Quality Control/Quality Assurance of bituminous concrete mixtures will not be paid for separately, but shall be considered as included in the cost of the various bituminous contract items.

Test Strips will be paid according to the following:

- (a) If the bituminous mixture placed during the initial test strip (1) is determined to be unacceptable to remain in place by the Engineer, and (2) was not produced within the tolerances of the JMF, the initial mixture and test strip will not be paid for and shall be removed at the contractor's expense. An additional test strip will be paid for in full, if produced within the JMF tolerances.
- (b) If the bituminous mixture placed during the initial test strip (1) is determined to be unacceptable to remain in place by the Engineer, and (2) was produced within the tolerances of the JMF, the mixture shall be removed. Removal will be paid for according to Article 109.04 of the Standard Specifications. This initial mixture and test strip will be paid for at the contract unit prices. The additional mixture shall be replaced at the contract unit price, and any additional test strips will be paid for at one half the unit price of each test strip.
- (c) If the bituminous mixture placed during a test strip is determined to be acceptable to remain in place by the Engineer and the Engineer deems a new start-up is required for any reason, the initial mixture and test strip will be paid for at the contract unit prices. The additional mixture will be paid for at the contract unit price and any additional test strips will be paid for at one half the contract unit price of each test strip.